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(54) Title: INCREASED CELL PACKET SWITCHED TRAFFIC CAPACITY
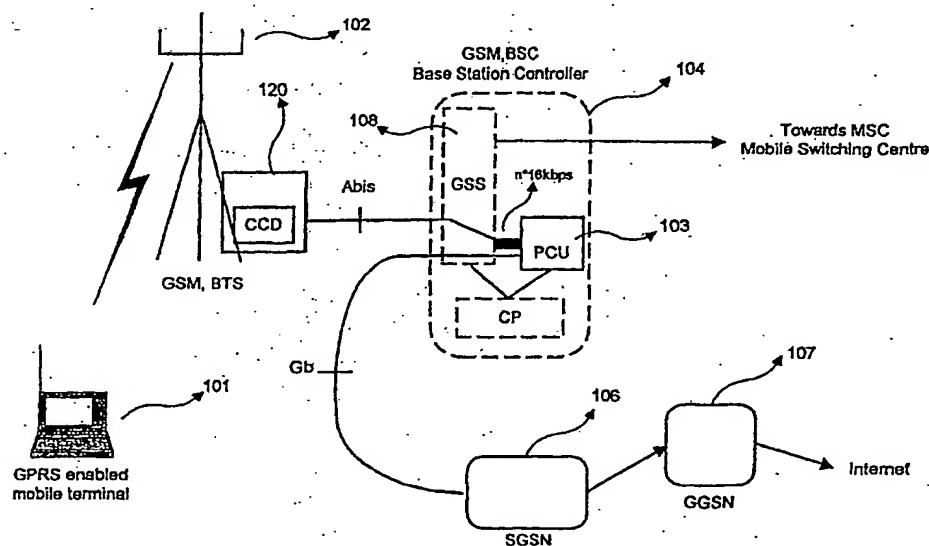
(57) Abstract

The invention concerns a method and a device for increasing cell packet switched traffic capacity in a mobile communication system wherein PRS, e.g. GPRS is implemented, said system comprising base station controller and a packet control unit, PCU, said PCU comprising at least two processors for handling traffic from at least two cells, said method characterized by the following steps: a) polling the data traffic load of the at least two processors, b) comparing the traffic load of each processor with a predetermined value, c) determining the traffic level in each cell supported by each of said at least two processors for any processor in which the predetermined value exceeded, d) thereafter relocating the cell exhibiting the lowest traffic level to a chosen processor.

Increased Cell Packet Switched Traffic capacity

FIELD OF THE INVENTION

The present invention generally relates to mobile communications, and more particularly to different features and methods that may be employed to establish and enhance communications, and more particularly to increasing the packet switched traffic in GPRS (General Packet Radio Services) applications. However the invention will also be applicable to other mobile systems such as UMTS (Universal Mobile Telecommunication System).

BACKGROUND OF THE INVENTION

The main application of most mobile radio systems like the Global System for Mobile communications (GSM) has been mobile telephony, which typically only supports circuit-switched communications where guaranteed , "fixed" circuits are dedicated to a user for the duration of a call. However, packet -switched applications, like facsimile transmissions and short message exchange, are becoming popular in mobile networks. Examples of this type of data transmissions include wireless personal computers, mobile offices, electronic funds transfer, etc. These data applications are characterized by "bursty" traffic where a large amount of data is transmitted over a relatively short time interval followed by significant time intervals when little or no data is transmitted.

This type of traffic may be transmitted using a circuit-switched channel, however, such a transmission does not utilise the channel in an efficient and cost-saving manner since it is likely that there will be times when the channel is reserved but is not being used. In this type of transmission the user does not share the channel with anyone else and he pays for the time he is connected.

An alternative to this type of transmission is the packet-switched type of transmission. Communication channels are in this type of system shared by several user simultaneously. This is accomplished by performing the transmission by sending grouped segments of the relevant data to be transmitted.

5

GPRS (General Packet Radio Services) is a standardised packet switched data service to be used in GSM-based systems. The GPRS and the GSM are designed to coexist without disturbances and GPRS is compatible with other data networks, e.g. IP and X.25. Using GPRS, data may be transmitted to and from the mobile radio

10 equipment, e.g. the mobile phone or a mobile wireless terminal. Using GPRS, the user may remain in contact with the accessed data network for as long as desired, but as mentioned above shares the channel with other users, thus only has to pay for the time he is transmitting data. This implies that in the future there is likely to be much more traffic on the channels than in the circuit-switched type transmissions,

15 which in any way would not allow for that much and kind of traffic.

As may be understood this will put a heavy load on the GSM-GPRS system in the future, the GSM dependent on the number of base transceiver stations and the num-

20 ber of cells connected to that base station. Each base transceiver station can carry a number of ongoing transmissions simultaneously depending on the architecture used.

SUMMARY OF THE INVENTION

25 The GPRS architecture utilises the existing GSM nodes and adds new ones for handling of packet switching, point to multi-point service handling and interworking with existing packet data networks. The additional packet switching nodes comprise a Gateway GPRS support Node (GGSN) and a Serving GPRS Support Node (SGSN). GGSN provides the interface towards external data networks. The

30 SGSN provides packet routing to and form the SGSN service area.

The transmitting of data through the packet channels is handled by one or more processors in a packet control unit (PCU) in a GSM Base station subsystem.

It should be noted that the packet control unit (PCU) may be located elsewhere. It may e.g. be co-located with the BTS (Base Transceiver Station) or may exist as an extra node.

There is a limit to the number of packet channels (PDCH's) which can be handled in such a processor, which has become evident with the knowledge of an increasing demand on the traffic. This is accentuated in case any of the RP's fail. Today's RPP processor can support 256 channels at the same time. An RP is a regional processor and RPP designates a specific regional processor.

A typical channel used in this type of a transmission occupies one time slot and is configured as a 16kb/sec channel that is capable of carrying GPRS traffic, i.e. a packet data channel, PDCH. There are two types of packet data channels (PDCH), fixed and on demand. Fixed PDCH's are permanently allocated in a cell for GPRS traffic and can not be used for circuit switched traffic unless they are pre-empted. The on-demand PDCH's are allocated on demand from the data traffic require-ments. These channels can be used for circuit switched traffic when they are not allocated for GPRS.

It is therefore an object of the present invention to increase the traffic capacity in cell packet switched traffic.

The present invention therefore provides a method for increasing the traffic capacity in a cell packet switched traffic and an apparatus having means for increasing the traffic capacity in cell packet switched traffic.

BRIEF DESCRIPTION OF THE DRAWINGS

Fig. 1 shows an exemplary Packet Control Unit (PCU) in a GSM Base Station Sub-
system (BSS) for General Packet Radio Services (GPRS).

Fig. 2 shows an implementation of a Base Station Controller (BSC) to be used in ac-
5   cordance with the present invention.

Fig. 3 shows a flow diagram over one embodiment of the method according to the
invention.

10   DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS OF THE INVENTION
These and other objects, advantages and features of the present invention will be
more readily understood from the following detailed description of a preferred em-
bodiments thereof, when considered in conjunction with the drawings wherein:

15   In Fig 1. is shown an overview of GSM Base Station Subsystem to be used with
GPRS. The system as shown comprises a GPRS enabled wireless mobile terminal
101. The terminal 101 is adapted to transmit or receive data via a GSM, BTS (Base
Transceiver Station) 102. The GPRS Packet Control Unit (PCU) 103 interfaces to
GSS 108 (a Group Switch) and handles data on 16 kbps channels in a CCD 120
20   (Channel Coding Device) style framing in the Abis interface between the Base sta-
tion 102 and the Base station controller 104. On the backbone side of the network,
the PCU 103 interfaces to the SGSN (Serving GPRS Service Node) 106 and the
GGSN (Gateway GPRS Service Node) 107 by 2Mbps wide-band Frame Relay con-
nections, the Gb interface 108. The GGSN 107 provides the gateway to Internet.

25
From the GSS 108 data are transmitted to a MSC (Mobile services Switching Cen-
tre) 121 for performing the telephony switching functions of the system.

Fig. 2 shows a Base Station Controller (BSC) 200 according to the present invention
30   and the coupling to the SGSN 201 via the Frame Relay Network 202 and an

Exchange Terminal Circuit (ETC) 206. The ETC 206 is a standardised interface connection device to the Group Switch (GS) 208.

An Ater Interface providing Transcoded CS speech/data from a BSC/TRC 203 via an ETC 207 is indicated as well as the Abis interface 204 connecting the BSC 200 and the Base Transceiver Station (BTS) 215.

The implementation of GPRS in the BSC 200 is done in a Central Processor (CP) 216 and a Packet Control Unit (PCU) 212. The PCU 212 comprises one or more regional processors (RP). The RP part may be configured as a single RP or, as is shown in the figure, as a multi RP connected by an Ethernet 221. The purpose of the multi RP is to achieve more Abis channels, among the existing channels 210.

The PCU 212 in the figure is shown as having three RP(regional processor) units 213-215, each comprising a Control Processor (CP), a Digital Signal Processor (DSP), and a Digital Link, variant 2, (dl2). Each dl2 connecting the unit with the substrate switch 211, except one dl2 in the RP 213, which connects to the SGNS 201 via the group switch (GS) 208. the group switch indicated is of a special type designated GSS

The RP's 213, 214, 215 are interconnected via an internal Ethernet 221, thus facilitating the re-disposition of the cells between the RP's.

Each RP handles a set of cells, i.e. "cells" are here used in the sense used in the art for mobile cellular telephones. One cell can only be handled in one RPP at any given point in time. Each RPP which is configured for Abis only (RPP_Abis) is predicted to be able to set up 256 packet channels while an RPP supporting Gb and Abis RPP_Gb can set up 128 packet channels.

The PCU 212 is coupled to the CP 216 via a serial bus 219 and the CP 216 is further coupled to the SRS 211 via a Transceiver Handler (THR) 217 and an ETC 218.

In the Fig. 2 is also shown that the circuit switched and packet switched channels are combined in the substrate switch 211 (SRS) for communication via the Abis Interface with the BTS 220 Base Transceiver Station.

5   The problem is thus as stated above that there may be a need for a larger number of channels within a few cells. As there is a limit on the number of packet channels a processor can support, GPRS coverage in many cells may be lost.

10   It has now been found that a redistribution of cells to processors having a lower traffic load can be made (i.e. processors supporting cells with high traffic density should support fewer cells than its peer processors).

Means are therefore provided in the processor for redistribution of cells when, and
15   if a processor is approaching its threshold.

Thus, according to the invention, when the system detects that a processor is within a certain percentage e.g. 5% of its maximum capacity (maximum capacity is determined by the number of packet channels the processor can set up), a channel
20   management function is set up for each RP exceeding the pre-decided percentage in order to determine the traffic level in each cell supported by the processor. The traffic level is measured as the number of packet channels set up in a cell. See Fig. 3.

25   The cell with the lowest traffic level is marked FORRELOCATION. Ongoing traffic (if any) in the cell is buffered and the cell is relocated to the chosen processor, Once relocated, data processing resumes. In the sense of the invention the cell with the lowest traffic level is the cell with the fewest packet data channels activated. If a channel is being used to transfer data it can only be used to transfer data in that cell.

30

If the relocation has not impacted the processor's load in a satisfactory manner, i.e. the processor is still within the threshold percentage of its maximum capacity the system will continue to poll the processor for the cell with the lowest traffic load and relocate that cell. Note that the cell with the lowest traffic level may have
5   few/no channels activated, thereby not improving the situation. However reallocating a cell with no channels is a preventive step and may avoid further future reallocations.

A further measure is to chose the processor with the lowest traffic load to support a
10   cell in which GPRS has been activated.

This type of dynamic allocating of cells among the available processors increases the GPRS cell coverage, thus offering a superior service to the user. Using the method according to the invention processor load will be distributed among the
15   available processors in the PCU thus allowing optimal capacity of the PCU to be utilised.

In a future mobile system like e.g. UMTS (Universal Mobile Telecommunication System) a PCU or an equivalent network entity implementing the same functionality
20   as the PCU described herein. Inherent the same principles and benefits of the present invention will be gained by the method adapted to such a mobile system.

Although the present invention has described in considerable detail with reference to a certain preferred version thereof, other versions are possible. GPRS has been
25   used as an example of PRS (Packet Radio Services). Therefore the spirit and scope of the appended claims should not be limited to the description of the preferred versions contained therein.

Claims

5   1.   A method for increasing cell packet switched traffic capacity in a mobile
communications system wherein PRS, e.g. GPRS is implemented, said system
comprising a base station controller and a packet control unit, PCU, said PCU
comprising at least two processors for handling traffic from at least two cells, said
method **characterized** by the following steps:

10   a)   polling the data traffic load of the at least two processors,
     b)   comparing the traffic load of each processor with a predetermined value,
     c)   determining the traffic level in each cell supported by each of said at least two
           processors for any processor in which the predetermined value is exceeded,
     d)   thereafter relocating the cell exhibiting the lowest traffic level to a chosen
15   processor.

2.   A method according to claim 1 **characterised** in that said packet control unit
PCU is part of the base transceiver station BTS.

20   3.   A method according to any preceding claim **characterised** in that any ongoing
traffic in the chosen cell is buffered during relocation of the cell to the chosen
processor and after relocation the data processing resumes.

4.   A method according any of the preceding claims **characterised** in that the
25   relocation of the cell results in a further polling of the data traffic load of any
processor having had a cell relocated, repeating the steps c) and d) of claim 1 if the
traffic load of said processor exceeds a predetermined value.

5.   A method according to any of the claims 1 - 4 **characterised** in that the mobile
30   communication system is a GSM system.

6.   A method according to any of the claims 1 - 4 characterised in that the mobile communication system is a UMTS system.

7.   A device for relocation of cells in a mobile communication system, e.g. a GSM-system in which PRS, e.g. GPRS may be implemented said system comprising a base station controller and a packet control unit, PCU, said PCU comprising at least two processors for handling traffic from at least two cells, characterised in said system having:

a)   means for polling the data traffic load of the at least two processors,

b)   means for comparing the traffic load of each processor with a predetermined value,

c)   means for determining the traffic level in each cell supported by each of said at least two processors for any processor in which the predetermined value is exceeded,

d)   means for relocating the cell exhibiting the lowest traffic level to a chosen processor.

8.   A device according claim 7 characterised in that the PCU is part of the base transceiver station BTS.

9.   A device according claim 7 or 8 characterised in that the mobile communication system is a GSM system.

10.   A device according claim 7 or 8 characterised in that the mobile communication system is a UMTS system.
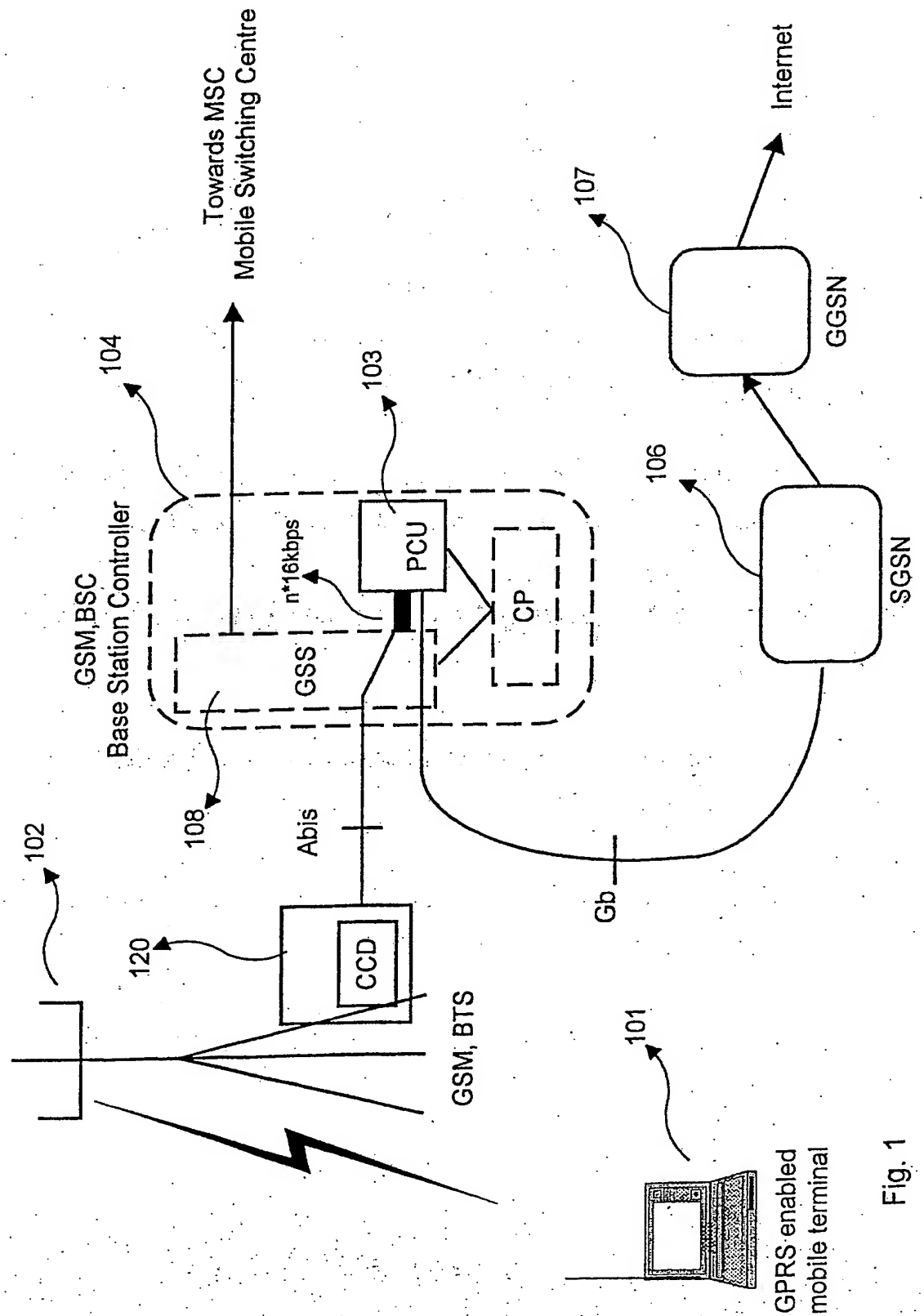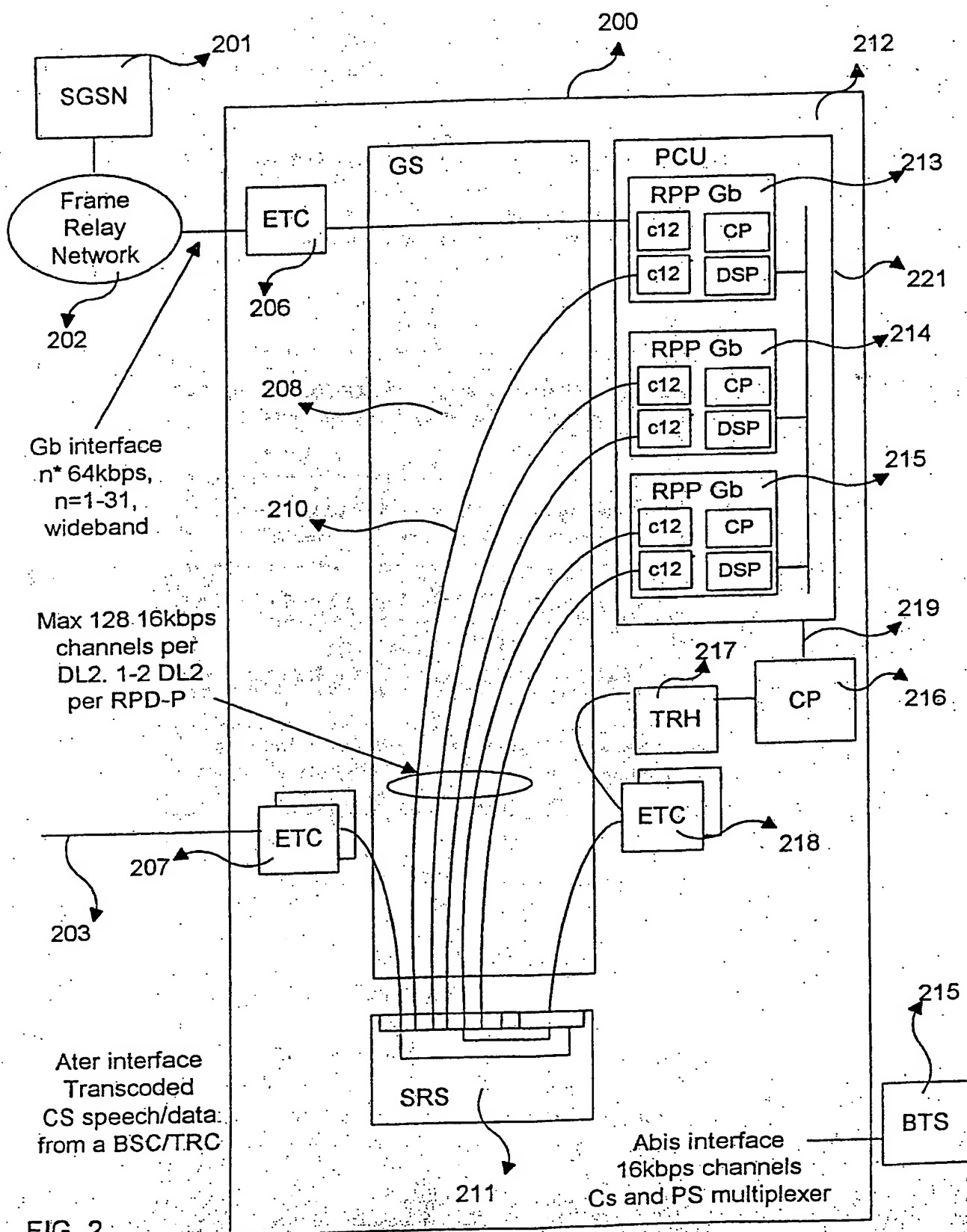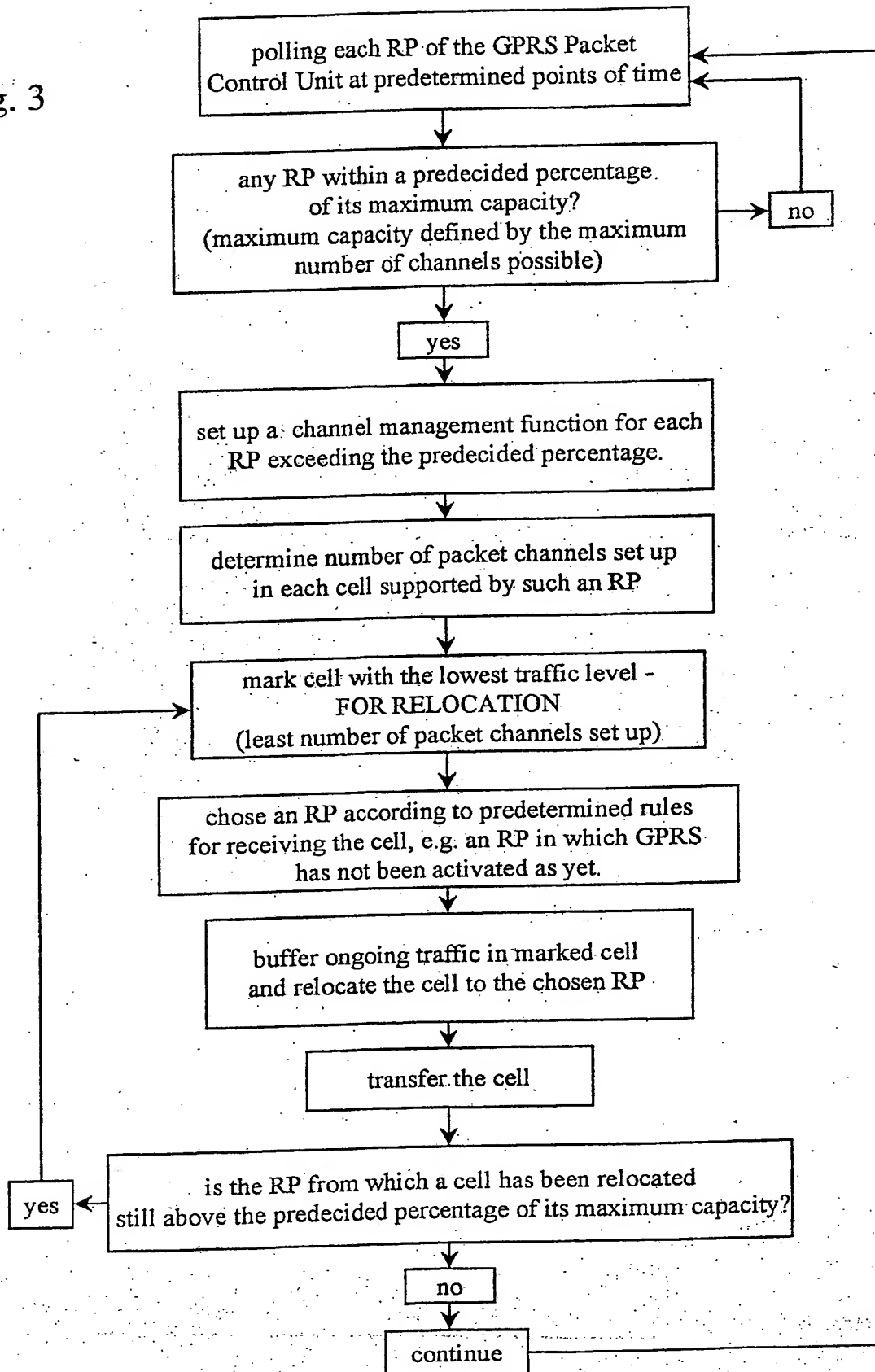
Fig. 1

FIG. 2

Fig. 3

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           ┌────────────────────────────────────────┐
           │   polling each RP of the GPRS Packet    │◄──────┐
           │ Control Unit at predetermined points of time │◄─┐│
           └────────────────────────────────────────┘      ││
                              │                             ││
                              ▼                             ││
           ┌────────────────────────────────────────┐      ││
           │   any RP within a predecided percentage  │    ┌──────┐  ││
           │        of its maximum capacity?          │───►│  no  │  ││
           │ (maximum capacity defined by the maximum │    └──────┘  ││
           │      number of channels possible)        │             ││
           └────────────────────────────────────────┘              ││
                              │                                     ││
                              ▼                                     ││
                          ┌───────┐                                 ││
                          │  yes  │                                 ││
                          └───────┘                                 ││
                              │                                     ││
                              ▼                                     ││
           ┌────────────────────────────────────────┐              ││
           │  set up a channel management function for each │       ││
           │     RP exceeding the predecided percentage.    │       ││
           └────────────────────────────────────────┘              ││
                              │                                     ││
                              ▼                                     ││
           ┌────────────────────────────────────────┐              ││
           │  determine number of packet channels set up │         ││
           │     in each cell supported by such an RP    │          ││
           └────────────────────────────────────────┘              ││
                              │                                     ││
                              ▼                                     ││
           ┌────────────────────────────────────────┐              ││
       ┌──►│     mark cell with the lowest traffic level -  │       ││
       │   │              FOR RELOCATION              │              ││
       │   │    (least number of packet channels set up) │          ││
       │   └────────────────────────────────────────┘              ││
       │                      │                                     ││
       │                      ▼                                     ││
       │   ┌────────────────────────────────────────┐              ││
       │   │  chose an RP according to predetermined rules │        ││
       │   │ for receiving the cell, e.g. an RP in which GPRS │     ││
       │   │        has not been activated as yet.    │              ││
       │   └────────────────────────────────────────┘              ││
       │                      │                                     ││
       │                      ▼                                     ││
       │   ┌────────────────────────────────────────┐              ││
       │   │   buffer ongoing traffic in marked cell  │             ││
       │   │    and relocate the cell to the chosen RP │            ││
       │   └────────────────────────────────────────┘              ││
       │                      │                                     ││
       │                      ▼                                     ││
       │               ┌──────────────┐                            ││
       │               │ transfer the cell │                       ││
       │               └──────────────┘                            ││
       │                      │                                     ││
       │                      ▼                                     ││
  ┌───────┐  ┌────────────────────────────────────────┐            ││
  │  yes  │◄─│  is the RP from which a cell has been relocated │    ││
  └───────┘  │ still above the predecided percentage of its maximum capacity? │  ││
             └────────────────────────────────────────┘            ││
                              │                                     ││
                              ▼                                     ││
                          ┌───────┐                                 ││
                          │  no   │                                 ││
                          └───────┘                                 ││
                              │                                     ││
                              ▼                                     ││
                        ┌──────────┐                                ││
                        │ continue │────────────────────────────────┘│
                        └──────────┘─────────────────────────────────┘
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INTERNATIONAL SEARCH REPORT

International application No.

PCT/SE 99/01868

A. CLASSIFICATION OF SUBJECT MATTER

IPC7: H04L 12/56

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC7: H04L

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

SE,DK,FI,NO classes as above

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

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X	WO 9535639 A2 (TELEFONAKTIEBOLAGET LM ERICSSON), 28 December 1995 (28.12.95), see the whole document	1-10
A	EP 0637895 A2 (MOTOROLA INC.), 8 February 1995 (08.02.95), column 3, line 48 - column 4, line 16; column 4, line 28 - line 34; column 12, line 12 - line 29, column 14, line 44 - column 15, line 53	1-10
A	GB 2313254 A (MOTOROLA LIMITED), 19 November 1997 (19.11.97), page 2, line 7 - line 22; page 3, line 21 - line 31	1-10

X	Further documents are listed in the continuation of Box C.	X	See patent family annex.

*	Special categories of cited documents:	"T"	later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
"A"	document defining the general state of the art which is not considered to be of particular relevance		
"E"	erlier document but published on or after the international filing date	"X"	document of particular relevance: the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
"L"	document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)	"Y"	document of particular relevance: the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
"O"	document referring to an oral disclosure, use, exhibition or other means		
"P"	document published prior to the international filing date but later than the priority date claimed	"&"	document member of the same patent family

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INTERNATIONAL SEARCH REPORT

International application No.
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C (Continuation).   DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	WO 9638013 A1 (PHILIPS ELECTRONICS N.V.), 28 November 1996 (28.11.96), page 2, line 4 - page 3, line 15	1-10
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